

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

1. (Currently amended) A method for automatically classifying spectral properties of audio data, comprising:
applying input audio data (1) to a critical band filtering process that filters the audio data proximate a human auditory frequency range to form first output data and (2) to an entropy calculation process to form second output data;
applying the first output data to a first derivative process to form third output data;
~~and~~
inputting said first, second and third output data to an averaging process to form a spectral feature vector representing the input audio data; and
comparing the spectral feature vector to a classification chain containing pre-classified entries to determine at least one classification of the audio data.

2. (Original) A method according to claim 1, wherein the audio data is divided into frames, and the method is performed frame by frame.

3. (Original) A method according to claim 1, further including calculating root mean squared values of the input audio data.

4. (Original) A method according to claim 2, wherein said entropy calculation process includes calculating:

$$S = - \sum_w p_w \log_2(p_w)$$

where S is the entropy of the frame, p_w is the normalized magnitude of a bin w of the audio data, and $\log_2(p_w)$ is the log base 2 of (p_w).

5. (Original) A method according to claim 2, wherein said first output data output from said critical band filtering process includes, for each critical band located due to the critical band filtering process, data resulting from summing the value of the square of the magnitude of each bin of data in the frame.

6. (Original) A method according to claim 2, wherein said first derivative process that forms said output data includes, for each critical band located due to the critical band filtering process, calculating the first derivative of data for each bin of data in the frame to gain information about the rate of change of the spectral frequencies represented by the frame.

7. (Original) The method of claim 1, further comprising converting the input audio data from the time domain to the frequency domain.

8. (Original) A method according to claim 7, wherein said converting of the input audio data signal from the time domain to the frequency domain includes performing a fast fourier transform on the audio data.

9. (Original) A method according to claim 2, wherein the averaging process is an averaging process over all of the frames to form the spectral feature vector for the audio data.

10. (Original) A method according to claim 1, further comprising applying the output vector to a classification process which determines at least one of (1) at least one spectral properties value and (2) at least one spectral properties class that describes the audio data.

11. (Original) A method according to claim 1, wherein the spectral feature vector for the audio data is a vector that is 1×25 .

12. (Original) A method according to claim 1, wherein the audio data is formatted according to pulse code modulated format.

13. (Original) A method according to claim 12, wherein the audio data is previously in a format other than pulse code modulated format, and the method further comprises converting the audio data to pulse code modulated format from the other format.

14. (Cancelled)

15. (Original) A method according to claim 12, wherein said converting of the input audio data signal from the time domain to the frequency domain includes performing a fast fourier transform on the audio data.

16. (Cancelled)

17. (Original) A method according to claim 1, further comprising performing a principal component analysis process on the spectral feature vector.

18. (Cancelled)

19. (Cancelled)

20. (Cancelled)

21. (Currently amended) A method of classifying data according to spectral properties of the data, comprising:

assigning at least one spectral properties class to each media entity of a plurality of media entities in a data set wherein said assigning is not based on digital signal processing;

processing each media entity of said data set to extract at least one spectral properties characteristic based on digital signal processing of each media entity;

generating a plurality of spectral properties vectors for said plurality of media entities, wherein each spectral properties vector includes said at least one spectral properties class and at least one spectral properties characteristic based on digital signal processing; ~~and~~

forming a classification chain based upon said plurality of spectral properties vectors and the at least one spectral properties class; and

comparing unclassified data to the classification chain to estimate a classification of the unclassified data.

22. (Original) A method according to claim 21, further comprising:
processing an unclassified media entity to extract at least one spectral properties characteristic based on digital signal processing of the unclassified media entity;
generating a vector for the unclassified media entity including said at least one digital signal processing spectral properties characteristic;
presenting the vector for the unclassified media entity to the classification chain; and
classifying the unclassified entry with an estimate of the spectral properties class by calculating the representative spectral properties class of the subset of the plurality of vectors of the classification chain located in the neighborhood of the vector for the unclassified entity.

23. (Original) A method according to claim 22, further including calculating a neighborhood distance that defines a distance within which two vectors in the classification chain space are in the same neighborhood for purposes of being in the same spectral properties class.

24. (Original) A method according to claim 22, wherein said classifying of the unclassified entry includes classifying the unclassified entry with a median spectral properties class represented by the neighborhood.

25. (Original) A method according to claim 22, wherein said spectral properties class is described by a numerical value and said classifying of the unclassified entry includes classifying the unclassified entry with a mean of numerical spectral properties values found in the neighborhood.

26. (Original) A method according to claim 22, wherein said classifying includes returning at least one number indicating the level of confidence of the spectral properties class estimate.

27. (Cancelled)

28. (Cancelled)

29. (Cancelled)

30. (Original) A computing system, comprising:
a computing device including:
a classification chain data structure stored thereon having a plurality of classification vectors, wherein each vector includes data representative of a spectral properties class as classified by humans and spectral properties characteristics as determined by digital signal processing; and
processing means for comparing an unclassified media entity to the classification chain data structure to determine an estimate of the spectral properties class of the unclassified media entity.

31. (Original) A computing system according to claim 30, wherein said determining of an estimate of the spectral properties class includes returning at least one number indicating the level of confidence of the spectral properties class assignment.

32. (Original) A method according to claim 31, wherein the performance level of the classification chain improves over time due to the examination of unclassified media entities that have a low confidence level associated with the spectral properties class assignment.

33. (Original) A classification chain data structure utilized in connection with the classification of spectral properties of new unclassified media entities, comprising:
a plurality of classification vectors, wherein each vector includes:
spectral properties data as classified by humans; and
spectral properties data determined by digital signal processing techniques.

34. (Currently amended) A method for classifying audio data according to its spectral properties, comprising:

- ~~a construction phase, comprising:~~
- classifying by human experts each entry of a representative set of sounds according to their spectral perceptual qualities;
- assigning each entry in the representative set at least one value based on digital signal processing;
- reducing the results ~~of the construction phase~~ to a set of numbers called the characteristic vector of each sound; ~~and~~
- storing the characteristic vector in a classification chain ~~for later calculations; and~~
- ~~a classification phase, comprising:~~
- ~~presenting an unclassified sound for classification;~~
- receiving a digital audio information;
- dividing the digital audio information into frames;
- determining a sonic characterization vector as a function of the energy, entropy and rate of change of frequencies in at least one frame; and
- presenting the characteristic vector to the classification chain, which returns an estimate of the spectral properties ~~of the unknown sound.~~

35. (Original) The method of Claim 34, wherein the reducing of the results of the construction phase to a set of numbers called the characteristic vector of each sound includes breaking up the sound into a plurality of frames of a fixed number of pulse code modulation values, each value representing a sample in the frame, determining the energy of the frame by calculating the root mean squared value of the frame, taking a fast fourier transform of the root mean squared value, and calculating the entropy content by normalizing the sum of the magnitudes of the bins of the fast fourier transform to unity for each frame and then calculating:

$$S = - \sum_w p_w \log_2(p_w)$$

where S is the entropy of the frame, p_w is the normalized magnitude of a bin w of the audio data, and $\log_2(p_w)$ is the log base 2 of (p_w), and calculating the mean and the standard deviation of each resulting value.